CLAIMS

1. An ink jet printhead comprising:

a plurality of nozzles, each nozzle having a nozzle aperture;

a bubble forming chamber corresponding to each of the nozzles respectively;

at least one heater element disposed in each of the bubble forming chambers respectively, the heater element configured for thermal contact with a bubble forming liquid; such that,

heating the heater element to a temperature above the boiling point of the bubble forming liquid forms a gas bubble that causes the ejection of a drop of an ejectable liquid through the nozzle corresponding to that heater element; wherein,

the heater element has a serpentine form configured to generate the gas bubble substantially symmetrically about an axis extending normal to the plane of the aperture.

2. The printhead of claim 1 wherein the axis extends through the center of the aperture.

3. The printhead of claim 1 wherein the bubble forming chamber has a circular cross section and the heater element extends between two adjacent electrodes spaced from each other by a gap, wherein the heater element has a second gap diametrically opposed to the gap between the electrodes.

4. The printhead of claim 1 wherein the serpentine form is a double omega shape wherein a first omega shape extends between two adjacent electrodes spaced from each other by a gap, and a second omega shape is inverted relative to the first and extending between a second gap in the first omega shape, the second gap in the first omega being positioned diametrically opposite the gap between the electrodes.

5. The printhead of claim 1 wherein the bubble forming liquid and the ejectable liquid are of a common body of liquid.

6. The printhead of claim 1 being configured to print on a page and to be a page-width printhead.

7. The printhead of claim 1 wherein each heater element is in the form of a cantilever beam.

8. The printhead of claim 1 wherein each heater element is configured such that an actuation energy of less than 500 nanojoules (nJ) is required to be applied to that heater element to heat that heater element sufficiently to form a said bubble in the bubble forming liquid thereby to cause the ejection of a said drop.

9. The printhead of claim 1 configured to receive a supply of the ejectable liquid at an ambient temperature, wherein each heater element is configured such that the energy required to be applied thereto to heat said part to cause the ejection of a said drop is less than the energy required to heat a volume of said ejectable liquid equal to the volume of the said drop, from a temperature equal to said ambient temperature to said boiling point.

10. The printhead of claim 1 comprising a substrate having a substrate surface, wherein the areal density of the nozzles relative to the substrate surface exceeds 10,000 nozzles per square cm of substrate surface.

11. The printhead of claim 1 wherein each heater element has two opposite sides and is configured such that a said gas bubble formed by that heater element is formed at both of said sides of that heater element.

12. The printhead of claim 1 wherein the bubble which each element is configured to form is collapsible and has a point of collapse, and wherein each heater element is configured such that the point of collapse of a bubble formed thereby is spaced from that heater element.

13. The printhead of claim 1 comprising a structure that is formed by chemical vapor deposition (CVD), the nozzles being incorporated on the structure.

14. The printhead of claim 1 comprising a structure which is less than 10 microns thick, the nozzles being incorporated on the structure.

15. The printhead of claim 1 comprising a plurality of nozzle chambers each corresponding to a respective nozzle, and a plurality of said heater elements being disposed within each chamber, the heater elements within each chamber being formed on different respective layers to one another.

16. The printhead of claim 1 wherein each heater element is formed of solid material more than 90% of which, by atomic proportion, is constituted by at least one periodic element having an atomic number below 50.

17. The printhead of claim 1 wherein each heater element includes solid material and is configured for a mass of less than 10 nanograms of the solid material of that heater element to be heated to a temperature above said boiling point thereby to heat said part of the bubble forming liquid to a temperature above said boiling point to cause the ejection of a said drop.

18. The printhead of claim 1 wherein each heater element is substantially covered by a conformal protective coating, the coating of each heater element having been applied substantially to all sides of the heater element simultaneously such that the coating is seamless.

19. A printer system which incorporates a printhead, the printhead comprising:

a plurality of nozzles, each nozzle having a nozzle aperture;

a bubble forming chamber corresponding to each of the nozzles respectively;

at least one heater element disposed in each of the bubble forming chambers respectively, the heater element configured for thermal contact with a bubble forming liquid; such that,

heating the heater element to a temperature above the boiling point of the bubble forming liquid forms a gas bubble that causes the ejection of a drop of an ejectable liquid through the nozzle corresponding to that heater element; wherein,

the heater element has a serpentine form configured to generate the gas bubble substantially symmetrically about an axis extending normal to the plane of the aperture.

20. The system of claim 19 wherein the axis extends through the center of the aperture.

21. The system of claim 19 wherein the bubble forming chamber has a circular cross section and the heater element extends between two adjacent electrodes spaced from each other by a gap, wherein the heater element has a second gap diametrically opposed to the gap between the electrodes.

22. The system of claim 19 wherein the serpentine form is a double omega shape wherein a first omega shape extends between two adjacent electrodes spaced from each other by a gap, and a second omega shape is inverted relative to the first and extending between a second gap in the first omega shape, the second gap in the first omega being positioned diametrically opposite the gap between the electrodes.

23. The system of claim 19 being configured to support the bubble forming liquid in thermal contact with each said heater element, and to support the ejectable liquid adjacent each nozzle.

24. The system of claim 19 wherein the bubble forming liquid and the ejectable liquid are of a common body of liquid.

25. The system of claim 19 being configured to print on a page and to be a page-width printhead.

26. The system of claim 19 wherein each heater element is in the form of a cantilever beam.

27. The system of claim 19 wherein each heater element is configured such that an actuation energy of less than 500 nanojoules (nJ) is required to be applied to that heater element to heat that heater element sufficiently to form a said bubble in the bubble forming liquid thereby to cause the ejection of a said drop.

28. The system of claim 19, wherein the printhead is configured to receive a supply of the ejectable liquid at an ambient temperature, and wherein each heater element is configured such that the energy required to be applied thereto to heat said part to cause the ejection of a said drop is less than the energy required to heat a volume of said ejectable liquid equal to the volume of the said drop, from a temperature equal to said ambient temperature to said boiling point.

29. The system of claim 19 comprising a substrate having a substrate surface, wherein the areal density of the nozzles relative to the substrate surface exceeds 10,000 nozzles per square cm of substrate surface.

30. The system of claim 19 wherein each heater element has two opposite sides and is configured such that a said gas bubble formed by that heater element is formed at both of said sides of that heater element.

31. The system of claim 19 wherein the bubble which each element is configured to form is collapsible and has a point of collapse, and wherein each heater element is configured such that the point of collapse of a bubble formed thereby is spaced from that heater element.

32. The system of claim 19 comprising a structure that is formed by chemical vapor deposition (CVD), the nozzles being incorporated on the structure.

33. The system of claim 19 comprising a structure which is less than 10 microns thick, the nozzles being incorporated on the structure.

34. The system of claim 19 comprising a plurality of nozzle chambers each corresponding to a respective nozzle, and a plurality of said heater elements being disposed within each chamber, the heater elements within each chamber being formed on different respective layers to one another.

35. The system of claim 19 wherein each heater element is formed of solid material more than 90% of which, by atomic proportion, is constituted by at least one periodic element having an atomic number below 50.

36. The system of claim 19 wherein each heater element includes solid material and is configured for a mass of less than 10 nanograms of the solid material of that heater element to be heated to a temperature above said boiling point thereby to heat said part of the bubble forming liquid to a temperature above said boiling point to cause the ejection of a said drop.

37. The system of claim 19 wherein each heater element is substantially covered by a conformal protective coating, the coating of each heater element having been applied substantially to all sides of the heater element simultaneously such that the coating is seamless.

38. A method of ejecting drops of an ejectable liquid from a printhead, the printhead comprising a plurality of nozzles, each nozzle having a nozzle aperture;

a bubble forming chamber corresponding to each of the nozzles respectively;

at least one heater element disposed in each of the bubble forming chambers respectively, the heater element configured for thermal contact with a bubble forming liquid;

the method comprising the steps of:

heating the heater element to a temperature above the boiling point of the bubble forming liquid to form a gas bubble that causes the ejection of a drop of an ejectable liquid from the nozzle; and

supplying the nozzle with a replacement volume of the ejectable liquid equivalent to the ejected drop. wherein,

the heater element has a serpentine form configured to generate the gas bubble substantially symmetrically about an axis extending normal to the plane of the aperture.

39. The method of claim 38 wherein the heater element extends between the electrodes mounted on opposite sides of the bubble forming chamber.

40. The method of claim 38 wherein the axis extends through the center of the aperture.

41. The method of claim 38 wherein the bubble forming chamber has a circular cross section and the heater element extends between two adjacent electrodes spaced from each other by a gap, wherein the heater element has a second gap diametrically opposed to the gap between the electrodes.

42. The method of claim 38 wherein the serpentine form is a double omega shape wherein a first omega shape extends between two adjacent electrodes spaced from each other by a gap, and a second omega shape is inverted relative to the first and extending between a second gap in the first omega shape, the second gap in the first omega being positioned diametrically opposite the gap between the electrodes.

43. The method of claim 38 wherein the printhead is configured to print on a page and to be a page-width printhead.

44. The method of claim 38 wherein said step of heating the at least one heater element is effected by applying an actuation energy of less than 500nJ to each such heater element.

45. The method of claim 38 wherein prior to the step of heating the at least one heater element, a supply of the ejectable liquid, at an ambient temperature, is fed to the printhead, wherein the step of heating is effected by applying heat energy to the at least one heater element, wherein said applied heat energy is less than the energy required to heat a volume of said ejectable liquid equal to the volume of said drop, from a temperature equal to said ambient temperature to said boiling point.

46. The method of claim 38 wherein the printhead includes a substrate on which said nozzles are disposed, the substrate having a substrate surface and the areal density of the nozzles relative to the substrate surface exceeding 10,000 nozzles per square cm of substrate surface.

47. The method of claim 38 wherein the at least one heater element has two opposing sides and the bubble is generated at both of said sides of each heated heater element

48. The method of claim 38 wherein the generated bubble is collapsible and has a point of collapse, and is generated such that the point of collapse is spaced from the at least one heater element.

49. The method of claim 38 wherein the printhead has a structure that is less than 10 microns thick and which incorporates said nozzles thereon.

50. The method of claim 38 wherein the nozzles of the printhead are formed by chemical vapor deposition (CVD).

51. The method of claim 38 wherein the printhead has a plurality of nozzle chambers each chamber corresponding to a respective nozzle and a plurality of said heater elements are formed in each of the chambers, such that the heater elements in each chamber are formed on different respective layers to one another.

52. The method of claim 38 wherein the heater elements are formed of solid material more than 90% of which, by atomic proportion, is constituted by at least one periodic element having an atomic number below 50.

53. The method of claim 38 wherein the heater elements include solid material and wherein the step of heating at least one heater element comprises heating a mass of less than 10 nanograms of the solid material of each such heater element to a temperature above said boiling point.

54. The method of claim 38 wherein a conformal protective coating is applied to substantially to all sides of each of the heater elements simultaneously, such that the coating is seamless.